U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE SYSTEMS DEVELOPMENT OFFICE TECHNIQUES DEVELOPMENT LABORATORY

TDL Office Note 75-1

COMPARATIVE VERIFICATION OF LOCAL AND GUIDANCE SURFACE WIND FORECASTS--NO. 2

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We have verified TDL's automated forecasts of surface wind for the months April through September 1974. These forecasts are based on the warm season (April-September) regression equations described in National Weather Service (NWS) Technical Procedures Bulletin No. 86 (NWS, 1973a).

We conducted this verification study in conjunction with the NWS combined aviation/public weather verification system (NWS, 1973b). Scores for our objective guidance forecasts are presented here along with corresponding scores for official local forecasts prepared at Weather Service Forecast Offices (WSFO's). Table 1 in TDL Office Note 73-12 (Carter et.al., 1974) shows the 92 stations used. The Technical Procedures Branch of the Office of Meteorology and Oceanography furnished us with the local forecasts.

Since the local forecasts are recorded as calm if the wind speed is expected to be less than 8 knots, the comparison is presented in two ways. For all those cases where both the local and guidance forecasts were at least 8 knots, the mean absolute error (MAE) of direction and speed, and the bias (mean forecast minus mean observed) of speed were computed. Cases where both the local and guidance forecasts were at least 8 knots and the observed wind was calm were eliminated from the MAE calculations for wind direction. Also, for all cases where local and guidance forecasts were available, skill score, percent correct, and bias by category were computed from wind speed contingency tables which have categories of less than 8, 8-12, 13-17, 18-22, and greater than 22 knots.

Tables 1-5 show verification scores for the 6-month period April through September 1974. Three projections are shown. For the guidance forecasts, which are made from 0000 GMT data, these are 18, 30, and 42 hours, and are so listed in the tables. However, the local forecasts are not released until 1000 GMT, so about 9 hours later data are available for their preparation. It should be noted that the objective speed forecasts were enhanced by the method described in NWS Technical Procedures Bulletin No. 102 (NWS 1973c).

Statistics for all 92 stations combined are shown in Table 1. The MAE scores for both direction and speed, as well as the skill scores and percents correct, indicate that the guidance forecasts were better than the local forecasts for all three projections. The magnitude of this advantage does not vary much with projection. The guidance forecasts are nearly unbiased in the mean; however, the individual biases by category from the contingency tables reveal a tendency to underforecast the higher wind speeds. The local forecasts are much better in this regard.

lTucumcari, New Mexico replaced Farmington, New Mexico in this current study.

Tables 2-5 show similar results for the NWS Eastern, Southern, Central, and Western Regions, respectively. Category two (8-12 knots) is overforecast by the objective system for all three projections in each region, while the frequencies of occurrence of categories four (18-22 knots) and five (greater than 22 knots) are underforecast.

For each Region the mean absolute errors, skill scores, and percents correct for the summertime objective guidance forecasts are better than those for the local forecasts from the WSFO's. This conclusion is the same as that reached for wintertime forecasts (Carter, et. al., 1974). However, the objecti forecasts have undesirable bias characteristics. We plan to improve this aspect of the forecasts with the implementation of new summer equations on April 1, 1975.

ACKNOWLEDGEMENT

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REFERENCES

- Carter, G. M., H. R. Glahn, and G. W. Hollenbaugh, "Comparative Verification of Local and Guidance Surface Wind Forecasts--No. 1," <u>TDL Office Note</u>, No. 74-12 (Revised), Techniques Development Laboratory, Silver Spring, Md., 1974, 8 pp.
- NWS, "Surface Wind Forecasts Based on Model Output Statistics (MOS)--No. 1,"

 <u>Technical Procedures Bulletin</u>, No. 86, 1973a, 11 pp.
- NWS, "Combined Aviation/Public Weather Forecast Verification," National Weather Service Operations Manual, Chapter C-73, 1973b, 14 pp.
- NWS, "Surface Wind Forecasts Based on Model Output Statistics (MOS)-No. 4," Technical Procedures Bulletin, No. 102, 1973c, 4 pp.

Comparative verification scores for NWS official local and TDL guidance surface wind forecasts at 92 stations across the United States during April through September 1974. Table 1.

		o'N	OF	CASES	••	14031	2	13907		14020	
				CATS CASES		.28	.48	8	.30	.03	9.
	TABLE		EGORY	CAT4		.47	.83	90.	69:	.24	49.
			CAT	CAT3		92.	1.09	.43	86.	.70	1.04
	CONTINGENCY		BIAS BY CATEGORY	CATZ		1.40	1.16	1.18	1.33	1.57	1.28
(TS)	CONTI		BÍ	CATI		.76	.82	1.02	.89	.65	.77
SPEED (KTS.)		PERCENT	FCST.	CASESSCORECORRECT	a •	53	49	. 89	19	20	. 46 .
SF			SKILL	SCORE		.28	.24	.32	.24	.22	-12
		Ö Z	0 0			7010	5	3250	٠.	8502	3
			BIAS			o.	₹	. - .	+ 55	0.	0.1
			MEAN BIAS	OBS.		11.2	11.2	9.9	6.0	10.8	10.8
		ABS. MEAN		FCST.		11.2	12.3	0.0	4.	10.8	8.
	ı	NO. MEAN	ABS.	ERROR		5.9	3.3	3.3	3.9		3.7
NOIL	2	S S	OF	CASES		7210	5	88	}	8426	3
DIRECTION	MEAN	ABS,	ABS, OF ABS MEAN (DEG) CASESERROR FCST.			34	34		36		20
		7 P.E	P.O	FCST.		GUIDANCE	LOCALS	GUIDANCE	LOCALS	GUIDANCE	LOCALS
	1	3.	PROJ.	(HRS.)		~ '0	0	, C	3		Į.

Comparative verification scores for NWS official local and TDL guidance surface wind forecasts at 24 stations in the Eastern Region of the NWS during April through September 1974. Table 2.

				S			<u> </u>				2
		NO.	OF	CASE		100	2885	755	5	2572	
				CAT4 CAT5 CASES	ş	.44	.68	00.	.20	00.	.29
	BLE		GORY			.54	.73	.04	60:1	15.	.52
	Y TA		CAT	CAT2 CAT3		69.	86.	.32	<u>6</u>	.62	94
	NGENC		BIAS BY CATEGORY	CATZ		1.44	1.20	1.07	1.48	1.60	1.27
TS.)	CONTINGENCY TABLE		BIE	CATI		99.	.78	1.04	85	.5	.74
SPEED (KTS.)	Û	PERCENT	FCST.	CASESSCORECORRECT		53	5	73	64	20	46
SP			SKILL	SCORE		.26	.24	.33	.25	8	<u>.</u>
	:	Ö.	PP	CASES			7414	2	<u></u> 5.	2400	7647
			BIAS			4.2	0.1+	+ 10	45.0	-	0
			MEAN BIAS	OBS.		0	0.1	9.6	9.4	9.01	9.01
			ABS. MEAN	FCST.		1.2	12.0	9.7	4.	10.7	9
		NO. MEAN	ABS.	ERROR		2.7	ا	3.0	3.9	3.0	
NOI	:	Š.	PP	CASES		2	740g	. 109	6	0070	2400
DIRECTION	MEAN	ABS.	ERROR	(DEG.) CASESERROR FCST.	8	35	37	37	39	45	48
	1	TYPE	P P	FCST.		GUIDANCE	LOCALS	GUIDANCE	LOCALS	GUIDANCE	LOCALS
		FCST.	PROJ.	(HRS)			<u> </u>	C	g .	,	4 4 4

Comparative verification scores for NWS official local and TDL guidance surface wind forecasts at 24 stations in the Southern Region of the NWS during April through September 1974. Table 3.

		NO.	CATSICASES		200	6600	3561	3590
					.47	1.35	92.	0 8
	TABLE	\a055	CAT3 CAT4		. 2	1.20	90. 8.	.88
		TVO	CAT3		8.	1.26	.53	.73
	NGENC	BIAS BY CATEGORY	CATZ		1.37	1.25	1.23	1.52
(KTS.)	CONTINGENCY	718	CATI		92.	.68	00.1	.70
SPEED (K		۵,	CASESSCORECORRECT		26	48	73	53 45
SF		SKII	SCORE		.30	.21	.38	. 25
	2	S C	CASES	٠.	2015	2	705	2061
		BIAS			4.	8 .	. 2. 0.	+ + ÷
		MEAN BIAS	OBS		10.5	10.5	10.6	10.2
		ABS. MEAN	FCST.		6.01	12.3	10.4	10.5
	- PAGA	ABS.	(DEG.) CASESERROR FCST.	2.5	2.7	3.3	3.3 5.4	3.7
TION			CASES	×	2002		694	2042
DIRECTION	MEAN	ABS.	(DEG.)		33	36	32	4 4 8 4
	7	9-1-0	WAY.		GUIDANCE	LOCALS	GUIDANCE	GUIDANCE
	FCCT	PROJ.	(HRS)	•	Ω	2	30	42

Comparative verification scores for NWS official local and TDL guidance surface wind forecasts 28 stations in the Central Region of the NWS during April through September 1974. Table 4.

NO.	PP	CASES		4282		4221			
2.		CATS		.22	.29	00.	44.	.04	60.
	GORY	CAT4		.48	.75	.13	.65	.24	.33
	CATE	CAT3		.83	91.	.49	.98	8.	1.14
	SBY	CATZ		1.37	6	1.22	1.53	1.62	1.36
	A B	CATI		92.	.70	1.01	92.	.5	.60
1 -	FCST.	CORRECT		49	45	- 19	52	45	4 .
	SKILL	SCORE	÷	.23	.20	.27	61.	5	21.
NO	PO	CASES		3505		2,00	5	1362	3201
•	BIAS			ا ن	φ. ÷	٠ ب	+.5	์ เมื	9.
	MEAN	OBS		6.1	6:1	6.6	6.6	4.	11.4
	MEAN	FCST.		9.11	12.7	10.2	1.4	Ξ	12.0
MEAN	ABS.	FROR		3.	3.5			3.5	3.0
NO.	OF	CASES		000		1	000	į	3217
MEAN	2000	(DEG.)		34	38	38	43		
TYPE	Ь	FCST.		GUIDANCE	LOCALS	GUIDANCE	LOCALS	ח אירוויים	LOCALS
FCST.	PROJ.	(HRS)							42
	TYPE MEAN NO. MEAN NO. PERCENT	TYPE ABS. OF ABS. MEAN MEAN BIAS OF SKILL FCST. BIAS BY CATEGORY	TYPE ABS. MEAN MEAN BIAS OF SKILL FCST. BIAS BY CATEGORY OF ERROR (DEG) CASESERROR FCST. OBS. CASESSCORECORRECT CATI CAT2 CAT3 CAT4 CAT5 CAT5 CAT5 CAT5 CAT5 CAT5 CAT5 CAT5	TYPE MEAN NO. MEAN MEAN BIAS OF SKILL FCST. BIAS BY CATEGORY OF ERROR OF ABS. MEAN MEAN BIAS OF SKILL FCST. BIAS BY CATEGORY FCST. (DEG.) CASESERROR FCST. OBS. CASESSCORECORRECT CATI CAT2 CAT3 CAT4	TYPE MEAN NO. MEAN MEAN BIAS OF SKILL FCST. BIAS BY CATEGORY OF ERROR OF ABS. MEAN MEAN BIAS OF SKILL FCST. BIAS BY CATEGORY FCST. (DEG.) CASESERROR FCST. OBS. CASESSCORECORRECT CATI CAT2 CAT3 CAT4 GUIDANCE 34 JOSE 3.1 11.6 11.93 JOSE .23 49 .76 1.37 .83 .48	TYPE MEAN NO. MEAN MEAN BIAS OF SKILL FCST. OF ERROR CASESSCORECORRECT CATI CAT2 CAT3 CAT4 GUIDANCE 34 3005 3.5 12.7 11.9 + .8 2036 .20 45 .70 1.19 1.16 .75	TYPE MEAN NO. MEAN MEAN BIAS OF SKILL FCST. OF ERROR OF ERROR FCST. OF SKILL FCST. BIAS BY CATEGORY CASESSCORECORRECT CATI CAT2 CAT3 CAT4 GUIDANCE 34 3005 3.1 11.6 11.93 3036 .23 49 .76 1.37 .83 .48 LOCALS 38 .35 12.7 11.9 + .8 .20 45 .70 1.19 1.16 .75 GUIDANCE 38 .35 3.4 10.2 9.9 + .3 1381 .27 61 1.01 1.22 .49 .13	TYPE MEAN NO. MEAN MEAN BIAS OF SKILL FCST. OF ERROR OF ERROR OF ERROR OF ERROR OF SKILL FCST. BIAS BY CATEGORY CASESSCORECORRECT CATI CAT2 CAT3 CAT4 CATA CAT3 CAT4 CAT5 CAT5 CAT5 CAT4 CAT5 CAT5 CAT5 CAT5 CAT5 CAT5 CAT5 CAT5 CAT6 CAT5 CAT5 CAT4 CAT6 CAT5 CAT5 CAT5 CAT6 CAT5 CAT7 CAT6 CAT7 CAT6 CAT7 CATA C	TYPE MEAN NO. MEAN MEAN BIAS OF SKILL FCST. FCST. (DEG.) CASESERROR FCST. OBS. CASESSCORECORRECT CATI CATZ CAT3 CAT4 CUIDANCE 34 3005 3.1 11.6 11.93 3036 .23 49 .76 1.37 .83 .48 CUIDANCE 38 1350 3.4 10.2 9.9 + .3 1381 .27 61 1.01 1.22 .49 .13 CUIDANCE 45 35 11.1 11.43 2.20 4550 1.62 .81 .24

Comparative verification scores for NWS official local and TDL guidance surface wind forecasts at 16 stations in the Western Region of the NWS during April through September 1974. Table 5.

	_				1						0		
		S.	OF.	CASE		•	2468		2469		2469		
				CATSCASES			71.	.39	8	.22	9	6	
	3LE		GORY	CATA			9	.67	00.	43	11.	.36	
	Y TABLE		CATE	CATA			.59	.83	.23	86.	.46	.57	
	GENC.		BIAS BY CATEGORY	CTATO	2 2		1.44	.87	1.19	.83	1.51	.97	
LS.)	CONTINGENCY		BIA	TVV	CALL		98.	1.13	1.02	60.1	.86	1.14	
SPEED (KTS.)		PERCENT	1		CASESSCORECORRECT		26	26	. 65	62	22	54	
SP			SKILL		SCORE		25	.24	.26	6.	.24	.17	
		Š.	H C	5	CASEC		0	77)	,	460	. 0	000	Aspendent Property
			BIAG				4	0:		¢ 1.7	i vi	+.7	-
		52	MEANI-RIAS	3	OBS.		Ξ	ΞΞ	9.6	9.6	10.6	10.6	
			A DC MEAN		FCST.		107	2 2	7.6	E.3	10.3	. <u></u>	
		NO. MEAN	00	AD3.	(DEG.) CASESERROR FCST.		4	3.5	rc	3.8	. لن ت	3.8	
NO	20	S S	L	5	CASES			219		453		289	
1010	חשבוח	MEAN	ABS.	ERROR	(DEG.)			36	, L	38	. 24	47	
		TYPE	l	5	FCST.			LOCALS		LOCALS	ה ה ה	LOCALS	-
		FCST.		PROJ.	(HRS)		9	8		30.	•	42	